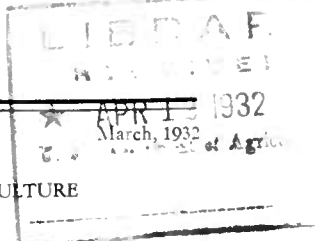




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REPELLENCY TO THE JAPANESE BEETLE OF EXTRACTS MADE FROM PLANTS IMMUNE TO ATTACK

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INTRODUCTION

A large number of plant species are apparently immune to the attack of the Japanese beetle (*Popillia japonica* Newm.), since the beetle has never been observed to attack them. These plants vary widely in habitat, structure, and physical appearance. Furthermore, to human olfaction, many of them give off strong characteristic odors, typical examples being pear, spearmint, and nasturtium. This immunity may be due to any of the factors mentioned. On the other hand, it is conceivable that the beetle may ignore them because they lack an attractive quality rather than because they possess any positive repellent characteristic.

During the course of investigations conducted to discover a repellent for the beetle, various causes of repellency were considered and, since it seemed plausible to assume that immune plants might owe their freedom from beetle attack to their content or secretion of substances toxic or distasteful to the insect, an investigation of the repellency of extracts from immune plants was undertaken.

Work on the project was begun in May, 1928, with D. H. Grant in charge of preparing the extracts and F. W. Metzger engaged in testing them in the field.² This arrangement continued until Mr.

¹ Resigned Oct. 1, 1929.

² The writers desire to express their appreciation to E. R. Van Leeuwen for his helpful suggestions, to R. J. Sim and Henry Fox for their assistance in locating and identifying various plants, and to W. W. Maines and Charles Wible for their conscientious work in the field and laboratory.

Grant resigned. The entire project was then transferred to Mr. Metzger, who carried on the work until its close in September, 1930. During the course of the investigation nearly 500 extracts were tested, which were derived from 390 species of plants. A complete botanical classified list of these plants is given at the end of this bulletin.

SELECTION OF PLANTS

At the beginning of the project it was decided to experiment with as many species of plants as possible, rather than to spend a considerable amount of time on a few. With a few exceptions, therefore, each plant was treated only once or twice in a simple manner.

All the available literature³ was first examined to ascertain what plants were known to be immune. This information was greatly increased by the personal observations of the writers and several other members of the laboratory staff. With an extensive list of immune plants at hand, a study was then made of their habitats and abundance. The latter factor was especially important, as it had previously been determined that a supply of 2,500 to 3,000 grams of each plant would be needed for a thorough test of the resulting extract. Many species were not tested because of their small size, which would have necessitated too great an expenditure of time in collecting a sufficient quantity. Still others were discarded because, while they were relatively common, no definite knowledge as to the location of an adequate supply could be obtained.

As it was desired to include a wide range of plant genera, the most abundant species of an immune genus was selected, although in the case of particularly large genera two or more species were sometimes chosen.

Certain of the species from which extracts were desired could not be found in sufficient quantity, and in several cases a supply of the identical dried plant was purchased from a commercial source. If the same species could not be obtained, it was often possible to acquire one closely related to it that was also immune.

In some cases both the dried and the fresh plants were extracted in order to ascertain which would be the more effective. Some of the immune plants are represented on the drug market by their dried roots, which are supposed to contain their active constituents in greatest concentration. A number of drug plants not indigenous to the area infested by the Japanese beetle were also extracted, because their content of odorous or pharmacologically active principles gave hope that they might be repellent.

During the first summer in which the project was conducted, and before the necessary equipment had been obtained, a number of commercial fluid extracts of plants were purchased and tested. These extracts were chosen according to the principles just stated. The commercial vegetable dyeing and tanning materials were employed to ascertain whether or not any of the readily available commercial plant products would be repellent to the beetle rather

³ SMITH, L. B., and HADLEY, C. H. THE JAPANESE BEETLE. U. S. Dept. Agr. Circ. 363, 66 p., illus. 1926.

SAFRO, V. I. SOME ORNAMENTAL TREES AND SHRUBS PRACTICALLY FREE FROM JAPANESE BEETLE ATTACKS. N. J. Dept. Agr. Circ. 133, 6 p. 1928.

— SOME GARDEN ORNAMENTALS PRACTICALLY UNHARMED BY JAPANESE BEETLES. N. J. Dept. Agr. Circ. 134, [2] p. 1928.

— SOME FARM CROPS PRACTICALLY FREE FROM JAPANESE BEETLE ATTACK. N. J. Dept. Agr. Circ. 136, [3] p. 1928.

than because these extracts were prepared from plants known to be immune to beetle attack.

Many of the cultivated plants were grown on the laboratory grounds, as they could not usually be collected from private fields or gardens. Most of the wild plants were collected within a radius of a few miles from the laboratory, which is situated several miles from the heavily populated Philadelphia and Camden areas.

METHODS EMPLOYED IN EXTRACTING PLANTS

DRY MATERIAL

The directions contained in the United States Pharmacopœia, tenth edition (process for fluid extracts), were followed, except that the total percolate was used without distillation. The volume of solvent used was adjusted so that about four times as many cubic centimeters of total percolate were obtained as there were grains of dried plant. Most dried plants retain about as many cubic centimeters of solvent as there are grains of plant. Thus, in order to obtain the required amount of percolate, it is necessary to use five times as many cubic centimeters of the solvent as there are grams of the plant.

The entire amount of solvent was prepared at one time and one-fifth of it poured over the plant and thoroughly stirred. The mass was kept in a closed container and allowed to macerate for eight hours at room temperature. It was then packed in a percolator, at least an inch of space being left at the top, and a sheet of filter paper was laid upon the surface to prevent channeling by the stream of solvent. The solvent was added until it began to filter through the cotton at the bottom of the percolator, when a cork was inserted to stop the flow. The material was then allowed to macerate for 48 hours, care being taken that the solvent always stood at least an inch above the filter paper. At the expiration of this period the cork was withdrawn and percolation begun. The remainder of the solvent was then placed in a bottle inverted over the top of the percolator, so that the mouth of the bottle was well within the percolator and a short distance above the filter paper. This allowed the solvent to trickle into the percolator as fast as it ran out at the lower end.

Pharmacopœial fluid extracts are reduced to a concentration at which each cubic centimeter of extract represents the useful principles extracted from 1 gram of dried plant. In the percolation process the first 100 c. c. of the percolate are usually reserved. Alcohol is then recovered from the remainder of the percolate, which is then concentrated at a temperature not exceeding 60° C. The extract is then dissolved and mixed in the reserve portion, after which sufficient menstruum is added to make the extract measure 1,000 c. c. As the extracts made by the writers were not concentrated by recovering the alcohol and by distillation, they were usually of such a strength that 4 c. c. represented 1 gram of dry plant material.

Dilutions of extracts for application in the field were always calculated to a basis of one part of original dry plant to so many parts of spray. For example, in the accompanying tables a dilution of "1/25" means that each 25 liters represents 1 kilogram of original dry plant. Such a solution would usually be prepared by taking 4 liters of an extract resulting from a percolation, as described above, and diluting it with water to make 25 liters.

FRESH MATERIAL

The following method for extraction of fresh plants was devised after considerable experimental work with various processes and types of apparatus. It has been found very satisfactory in making nearly all the extracts.

In cutting the fresh plant a machine (fig. 1) was employed such as is used in hotels and restaurants for chopping cabbage, onions, celery, etc. It consists of a pair of rapidly rotating knives in a bowl which constantly turns so as to bring the material repeatedly under the knives. This machine is operated by a motor and works equally well with leaves, flowers, and practically all parts of plants except the tough woody stems. The material was placed in the cutter and chopped as finely as possible. Not more than 10 minutes was allowed for each batch, however, as the material became warm after that period, and there was danger of loss through oxidation and volatilization.

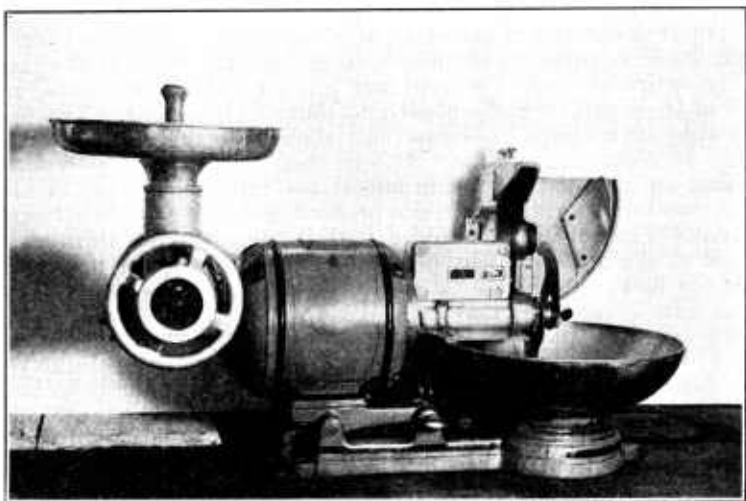


FIGURE 1.—Machine used to cut fresh plants

The chopped material was placed in a container and weighed. As many cubic centimeters of solvent were added as there were grams of plant. The mass was then thoroughly stirred, tightly covered, and allowed to stand overnight. The next morning the material was extracted in a centrifuge (fig. 2) having a perforated cylindrical bronze basket 11 inches in diameter. This basket, as well as the receiver surrounding it, was silver-plated to prevent reaction of acid plant juices with the bronze. The basket was first lined with muslin to prevent the holes in its sides from becoming clogged by the plant and then the material was loaded evenly into it. The centrifuge was speeded up to 3,000 revolutions per minute and allowed to run until only a few drops of the extract ran out during a minute's time. It was then slowed down considerably, and 100 c. c. of solvent was poured into the basket by directing the stream on the shoulder of the bearing within, thereby scattering the solvent fairly uniformly over

the material. The centrifuge was stopped for one minute and then again run at its former speed until the drops ran out slowly. This washing process was usually repeated four times.⁴

It was assumed that most fresh plants lose about 75 per cent of their weight on drying; therefore, an extract made from a fresh plant



FIGURE 2.—Centrifuge employed in plant extraction

was usually considered to be one-fourth as strong as an extract of the same volume made from the same weight of plant in a dried condition. An illustration of the method of reducing the quantity of extract from a fresh plant to terms of that from a dried plant

⁴JUILLET, A. LE PYRÉTHRE INSECTICIDE DE DALMATIA. ORIGINE, CULTURE, PRINCIPES ACTIFS, APPLICATIONS À L'AGRICULTURE. 236 p., illus. Montpellier, 1924.

follows: 4,000 c. c. of extract are obtained from 3,000 grams of fresh plant or 750 grams of dried plant; therefore, 5.3 c. c. of this extract represents 1 gram of dried plant. All extracts from fresh plants were applied on this basis.

SOLVENTS

In an intensive study of a few plant extracts it is desirable that each plant be treated with several solvents and in as many ways as possible in order to insure a complete extraction of all active principles. Unlimited work could be done on a single plant if an effort were made to isolate and test all possible individual constituents. When, however, it is intended to examine a wide range of plants in a comparatively short time, such a course becomes impracticable and a fairly simple, uniform treatment must be accorded each plant.

Certain of the fresh plants mentioned in this paper, such as potato, tobacco, and tomato, were treated with several solvents, and the resulting extracts, representing different classes of plant constituents, were tested separately. Most of the plant species, however, were treated with only one solvent. After careful consideration it was decided that more of the active plant principles could probably be extracted by the use of alcohol, or alcohol and water, than by any other solvent. These two agents were employed almost exclusively on fresh plants. Ethyl alcohol, 95 per cent, was used at full strength on a large number of plants, and the same solvent diluted 50 per cent with water on others.

Many of the dried plants that were extracted are used in medicinal preparations, and the solvents used on these plants were in accordance with the indications given in the United States Dispensatory, Wood and LaWall, twenty-first edition.

It is believed that the extractions were reasonably complete as regards alcohol-soluble constituents of the plants. Since such constituents include all the essential oils and most resins, glucosides, and alkaloids, it is evident that the method used probably yielded an extract containing all the substances from each plant which were most likely to possess repellency, with the exception of toxic proteins.

As the exact nature of the repellent principles contained in each plant was unknown, it was deemed advisable to test the extracts without recovering the alcohol. Distillation, even under reduced pressure, might carry off certain substances, such as essential oils, which should be retained in the extracts, besides entailing the danger of thermal decomposition or polymerization of unstable organic substances. The presence of the alcohol in the extracts was not considered objectionable in field tests, as ethyl alcohol at full strength is only slightly attractive to the beetle. It was never present in the diluted extracts at more than a 5 per cent concentration and soon evaporated when applied in spray form. The same may obviously be true of the more volatile portions of the plant extractives.

EXPERIMENTAL PROCEDURE IN THE FIELD

Most of the extracts were tested on small peach and apple trees of several varieties, and on larger peach trees of the Early Rose variety. The small trees were employed during 1929 and 1930 and bore no fruit during either year, not having reached the bearing age. The

large trees were used for three summers; they had a fair crop of fruit in 1928 and 1929, but very little in 1930 because of adverse climatic conditions. Each of the large trees required 3 gallons of spray per application, the smaller peach trees from 1 to 1½ gallons, and 2 quarts of spray were necessary for the apple trees. One or two of the large trees and two or three of the small ones were used in each test. When rain followed a treatment before the desired data were obtained, a second, and sometimes a third, application was made in order that observations might be taken while the substance was at its maximum strength.

A few tests were conducted on corn, on roses, and on smartweed in cages. The corn, which was in silk, was treated by pouring the extracts directly over the tops of the ears so that the silk became thoroughly drenched.

The degree of infestation at the time each test was begun was estimated according to the criteria given in Table 1. After an extract was applied the number of beetles present on the treated trees was observed at intervals of not more than 24 hours. Numerous check trees, located in all parts of the experimental orchards so that the infestation of each treated tree could be compared with that of an untreated tree in its immediate vicinity, were observed at like intervals. The checks were sprayed with water at the time a test was begun, but otherwise they were untreated. The observations were continued as long as a material showed any repellency, or as long as was necessary to obtain an indication of the value of the extract.

TABLE 1.—*Criteria employed in estimating infestation*

Infestation	Number of beetles per tree on—		
	Apple trees	Small peach trees	Large peach trees
Very light.....		0 to 10.....	0 to 25.....
Light.....	0 to 5.....	11 to 25.....	26 to 100.....
Moderate.....	6 to 20.....	26 to 100.....	101 to 250.....
Heavy.....	Over 20.....	Over 100.....	Over 250.....

The sprays were applied with a bucket pump in 1928 and 1929. During 1930 a small power spray outfit (fig. 3) was employed, and a much better coating was obtained.

In working with the Japanese beetle, one of the greatest difficulties encountered is the brevity of the period in which field tests can be conducted. During the three summers in which this work was in progress accurate results could be obtained only between July 1 and August 15.

RESULTS

A complete report of all the materials tested is too voluminous to be included in this bulletin. The greater number of the extracts gave no indications of being repellent to the beetle, and such extracts are merely listed in the botanical classification (Table 4), together with the respective solvents and the dilution rate. The extracts which were repellent to any extent are discussed in the following paragraphs.

REPELLENCY AFTER HEIGHT OF BEETLE SEASON

The following plant extracts, when applied on one large, moderately infested peach tree just after the height of the beetle season, exhibited repellent qualities:

Material	Dilution
Comandra (<i>Comandra umbellata</i> (L.) Nutt.)	1/25
Common rue (<i>Ruta graveolens</i> L.)	1/25
Gerardia (<i>Aureolaria pedicularia</i> (L.) Raf.)	1/25
Hawkweed (<i>Hieracium pratense</i> Tausch.)	1/30
Jersey-tea (<i>Ceanothus americanus</i> L.)	1/30
Kentucky coffeetree (<i>Gymnocladus dioica</i> (L.) Koch.) (light infestation)	1/35
<i>Pinus</i> sp. (needles)	1/50
Shepherd's-purse (<i>Bursa bursa-pastoris</i> (L.) Britton)	1/25
Swamp-pink (<i>Helonias bullata</i> L.)	1/25
Thoroughwort (<i>Eupatorium hyssopifolium</i> L.)	1/40
<i>Unifolium canadense</i> (Desf.) Greene	1/30



FIGURE 3.—Outfit used in applying plant extracts during 1930

None of the extracts tested in this orchard while the infestation was increasing proved to be even slightly repellent, and it is questionable whether any of these 11 extracts would have shown repellent qualities had they been tested earlier in the season.

The repellency of these substances, moreover, was not so strongly marked as that exhibited by derris and pyrethrum powders used at the rate of 3 pounds to 50 gallons of water and applied at the same time as the extracts.

Further tests with these domestic plant extracts before the height of the beetle season will be necessary in order definitely to establish their repellent value.

REPELLENCY ON CORN

Ten extracts tested separately at full strength on corn reduced infestation 40 to 76 per cent. (Table 2.) The corn was treated near the end of the beetle season in 1930, when the insect was becomi-

ing less numerous, and on three check plots where water was poured on the ears the infestation decreased 18 per cent in 24 hours. This factor was considered when computing the degree of repellency on the treated plots, which in each case was 18 per cent greater than indicated in the table. All the extracts except coreopsis included in Table 2 burned the husks severely, probably because of the alcohol they contained, but this is not believed to have influenced the results, as many other extracts which also caused serious burning showed no repellency. Although the burned husks had a dried appearance, an examination of a large number of ears revealed that the effect on the kernels was apparently negligible.

TABLE 2.—*Plant extracts repellent on corn when given one application at full strength on heavily infested ears*

Material	Ears treated	Repellency 24 hours after application	Ears burned 24 hours after application
	Number	Per cent	Per cent
Afghan blistercress (<i>Erysimum perofskianum</i> Fisch. and Mey.)	43	40	60
Black-eyed-susan (<i>Rudbeckia hirta</i> L.)	62	56	60
Blueberry (<i>Vaccinium</i> sp.)	15	54	100
Chiretta (<i>Swertia chirayita</i> (Roxb.) Lyons)	60	62	70
Cocillana (<i>Guarea ruschyi</i> (Britton) Rusby)	39	69	100
Common prickly-ash (<i>Zanthoxylum americanum</i> Mill.)	56	76	90
Coreopsis (<i>Coreopsis grandiflora</i> Hogg.)	19	60	0
Hickory (<i>Hicoria</i> sp.)	61	58	75
Horseweed (<i>Erigeron canadensis</i> L.)	92	68	66
Redroot (<i>Gyrotheca tinctoria</i> (Walt.) Salisb.)	20	50	5

The extracts of horseweed, cocillana, and common prickly-ash were the most effective repellents on corn. Horseweed and prickly-ash were also effective when applied at a dilution of 1/25 on small apple trees.

COMMERCIAL EXTRACTS USED IN DYEING AND TANNING

The following commercial vegetable extracts which are used in the dyeing and tanning industries also gave effective repellency when applied in a 1/25 dilution on two occasions on a large peach tree that was bearing fruit at the time of application:

Material	Character of residue
American chestnut (<i>Castanea dentata</i> (Marsh.) Borkh.)	Light.
Black oak (quercitron) (<i>Quercus velutina</i> Lam.)	Dark colored.
Divi-divi (<i>Caesalpinia coriaria</i> Willd.)	Heavy.
Fustic (<i>Chlorophora tinctoria</i> (L.) Gaud.)	Bright yellow.
Gallnut (<i>Quercus</i> spp.)	Yellow.
Gambier (<i>Ouroparia gambia</i> (Hunter) Baillon)	Brown.
India-almond (<i>Terminalia catappa</i> L.)	Light.
Logwood No. 1 (<i>Haematoxylon campechianum</i> L.)	Heavy brown.
Logwood No. 2 (<i>Haematoxylon campechianum</i> L.)	Do.
Osage-orange (<i>Toxylon pomiferum</i> Raf.)	Do.
Quebracho (<i>Schinopsis</i> sp.)	Do.
Sydney wattle (<i>Acacia longifolia</i> Willd.)	Brown.
Valonia (<i>Quercus</i> spp.)	Light colored.

All these substances left a conspicuous residue, which probably accounts for their repellent action. The residues from fustic, logwood No. 1, black oak, valonia, and wattle extracts possessed excellent

sticking qualities and remained on the fruit longer than any of the other commercial extracts mentioned.

There was sufficient rain, however, just before the fruit was harvested to remove most of this residue, and there was no loss in marketable fruit that could be attributed to the treatment.

New Jersey dry mix, which consists of sulphur 8 parts, hydrated lime 4 parts, and calcium caseinate one-half part, was applied at the rate of 12½ pounds to 50 gallons of water under the same conditions as were the extracts, and its use resulted in excellent protection to fruit and foliage. This material was more effective as a repellent than any of the extracts which have been tested.

EXTRACTS REPELLENT AT FULL STRENGTH BUT NOT AT 1/25 DILUTION

Several other extracts were repellent when employed at full strength but were ineffective when used in diluted form. Included in this group are the extracts of black-eyed-susan, coreopsis, castor-bean plant, sweetbay, cocillana, hickory, holly, and redroot. It would be impracticable to use these materials at full strength as a control measure, but as the only other concentration employed was 1/25, it appears that some repellency might be obtained at a concentration between these two extremes.

Extracts of goldenrod and *Aureolaria pedicularia* were repellent when used at 1/25 on peach and apple trees, respectively, but were not repellent at full strength on corn. The corn, however, was heavily infested when the treatments were made, whereas the infestation on the fruit trees was negligible. It is well known that a stronger repellent is needed to reduce an infestation of the Japanese beetle than is required to prevent one.

EXTRACTS REPELLENT ON SMALL PEACH AND APPLE TREES

Twenty-two extracts tested on small peach or apple trees gave indications of being more or less effective repellents. (Table 3.) Horseweed, chiretta, and prickly-ash extracts were also repellent on corn. Goldenrod extracts, also tested on corn, were not repellent. Aloe extract, when used at full strength on smartweed in cages, did not prevent extensive feeding. Common box was tested on both apple and peach trees. The other 16 materials in this group—namely, bearberry, betony, black oak, Christmas-rose, comfrey, false-hellebore, fennel-flower, holly, mayapple, New England aster, pimpinella, purple trillium, rosemary (flowers), springbeauty, sweetbay, and white turtlehead—were tested on only one kind of foliage. The tests with these extracts were by no means extensive enough to warrant the results being considered more than preliminary in nature.

TABLE 3.—*Extracts repellent on small peach and apple trees*

Material	Dilution	Number and kind of trees	Infestation at first application	Number of applications
American holly (<i>Ilex opaca</i> Alt.)	1/25	2 apple	None	1
Bearberry (<i>Arctostaphylos uva-ursi</i> (L.) Spreng.)	1/25	2 peach	Very light	2
Black oak (<i>Quercus velutina</i> Lam.)	1/25	2 apple	None	2
Chiretta (<i>Swertia chirayita</i> (Roxb.) Lyons)	1/25	do	do	2
Christmas-rose (<i>Helleborus niger</i> L.)	f. s.	3 apple	Light	1
Common betony (<i>Stachys officinalis</i> (L.) Franch.)	1/25	2 peach	Very light	2
Common box (<i>Buxus sempervirens</i> L.)	1/50	1 peach	Moderate	2
Do.	1/50	1 apple	do	2
Common comfrey (<i>Symphytum officinale</i> L.)	1/25	2 peach	None	2
Common mayapple (<i>Podophyllum peltatum</i> L.)	1/25	do	do	1
Common prickly-ash (<i>Zanthoxylum americanum</i> Mill.)	1/25	2 apple	do	1
False-hellebore (<i>Veratrum alhum</i> L.)	1/25	3 apple	do	3
Fennel-flower (<i>Nigella sativa</i> L.)	f. s.	do	Moderate	1
Goldenrod (<i>Solidago</i> sp.)	1/25	2 apple	None	2
Horseweed (<i>Erigeron canadensis</i> L.)	1/25	do	do	1
New England aster (<i>Aster novae-angliae</i> L.)	1/25	do	do	2
Pimpinella (<i>Pimpinella saxifraga</i> L.)	f. s.	do	do	1
Purple trillium (<i>Trillium erectum</i> L.)	1/25	2 peach	do	2
Rosemary (flowers) (<i>Rosemarinus officinalis</i> L.)	1/25	2 apple	do	2
Sweetbay (<i>Magnolia virginiana</i> L.)	f. s.	do	do	1
True aloe (<i>Aloe vera</i> L.)	1/25	2 peach	do	2
Virginia springbeauty (<i>Claytonia virginica</i> L.)	1/25	2 apple	do	2
White turtlehead (<i>Chelone glabra</i> L.)	1/25	2 peach	do	2

¹ f. s. = full strength.

MISCELLANEOUS

Winterberry extract (*Ilex paraguariensis* St. Hil.), applied twice at a dilution of 1/25 on a large peach tree lightly infested at the time of the first application, and castor-bean extract (*Ricinus communis* L.), applied at full strength on smartweed in cages upon which beetles fed but lightly, also showed some repellency to the Japanese beetle.

SUMMARY AND CONCLUSIONS

During the three years in which this project was conducted, 474 extracts, representing 390 plant species, were tested. These 390 plants were taken from 326 genera and 108 families. Several extracts were made from tomato, tobacco, and potato, and certain other plants were extracted in both the fresh and dry states. Although the number of immune plants has by no means been exhausted, it is believed that a fairly comprehensive survey has been made.

Only 56 extracts gave any indication of repellency. Thirteen of these were commercial extracts which probably repelled because of a conspicuous residue deposited on the foliage. Other white materials, such as lime and the New Jersey dry mix, repelled equally as well.

The repellent value of 11 other extracts was doubtful, as they were applied after the peak of the beetle season and were not subjected to such a severe test as were many of the other extracts. The repellency of these materials was much less than that shown by powdered derris and pyrethrum applied in spray form at the rate of 3 pounds to 50 gallons of water.

Ten extracts, each used at full strength on corn, were repellent, but only three were of possible value. All three burned the husks severely. In addition, the use of a plant extract at full strength would be too costly to be practical as a control measure.

Of the 22 extracts showing repellency on small peach and apple trees, 15 were repellent on small apple, 6 on small peach trees, and 1 on small peach and small apple trees. One extract showed some re-

pellency on smartweed in cages, and 1 on a large peach tree. Three extracts were repellent on both corn and apple.

The writers believe that the only extracts which might be tested more extensively with profit are those listed under "Extracts repellent on small peach and apple trees." Further work could be conducted with extracts of plant species not yet tested, but as the more abundant and important immune plants have been extracted, it is doubtful whether a continuation of this investigation would result in the discovery of a practical repellent for the Japanese beetle.

BOTANICAL CLASSIFICATION OF PLANTS EXTRACTED

A botanical classification of all plants extracted is given in Table 4. The solvent used and plant part employed are listed for each extract. Families are arranged in alphabetical order.

TABLE 4.—*Botanical classification of plants extracted, together with solvent, part used, and rate of application*

[Key to abbreviations: a, alcohol; ac, acetic acid; an, acetone; b, benzol; c, chloroform; g, glycerin; p, petroleum ether; pn, petroleum naphtha; w, water; f. s., full strength]

Family and scientific name	Common name	Solvent	Part used	Dilution
Aceraceae:				
Acer rubrum L.....	Red maple.....	a	Fresh leaves.....	1/25
Acer saccharinum L.....	Silver maple.....	a	.....do.....	1/30
Amaranthaceae: Amaranthus retroflexus L.....	Pigweed.....	a	Fresh leaves and stalks....	1/25
Amaryllidaceae: Narcissus pseudonarcissus L.....	Common daffodil.....	a	Fresh, entire plant in flower.....	1/25
Anacardiaceae:				
Rhus glabra L.....	Smooth sumac.....	a	Fresh leaves and fruit.....	1/50
Do.....	.....do.....		N. F. extract.....	1/64
Rhus sp.....	Sumac.....		2 commercial extracts.....	1/25
Rhus aromatica Ait.....	Fragrant sumac.....	a-w	Dry bark.....	1/25
Apiaceae:				
Angelica archangelica L.....	Angelica.....		N. F. extract.....	1/64
Cicuta maculata L.....	Spotted waterhemlock.....	a	Fresh leaves and flowers....	1/50
Conium maculatum L.....	Poison hemlock.....	a	Dry fruit.....	1/35
Do.....	.....do.....	a-w-ac	.....do.....	1/25
Daucus carota L.....	Common carrot.....	a	Fresh entire plant in flower.....	1/50
Do.....	.....do.....	a-w	.....do.....	f. s.
Foeniculum vulgare Hill.....	Common fennel.....	a-w	Dry seed.....	1/25, f. s.
Imperatoria ostruthium L.....	Masterwort.....	a	Dry root.....	1/25
Pastinaca sativa L.....	Parsnip.....	a	Fresh leaves and tops.....	1/25
Pimpinella anisum L.....	Anise.....	a-w	Dry fruit.....	1/50
Pimpinella saxifraga L.....	Pimpinella.....	a-w	Dry rhizome and root.....	1/25
Sium laeve Walt.....	Waterparsnip.....	a	Fresh entire plant in flower.....	1/25, f. s.
Apocynaceae:				
Apocynum cannabinum L.....	Hemp dogbane.....		N. F. extract.....	1/64
Do.....	.....do.....	a	Dry rhizome and root leaves.....	1/25
Apocynum androsaemifolium L.....	Spreading dogbane.....	a	Fresh pods.....	1/50
Do.....	.....do.....		U. S. P. extract.....	1/64
Schinopsis sp.....	Quebracho.....		Commercial extract.....	1/25
Strophanthus kombe Oliver.....	Strophanthus.....		U. S. P. extract.....	1/125
Aquifoliaceae:				
Ilex opaca Ait.....	American holly.....	a	Fresh leaves.....	1/25, f. s.
Ilex paraguariensis St. Hil.....	Paraguay-tea.....	a-w	Dry leaves.....	1/25
Ilex verticillata (L.) A. Gray.....	Common winterberry.....	a-w	Dry bark.....	1/25
Araceae:				
Acorus calamus L.....	Sweetflag.....	a-w	Fresh leaves.....	1/25, f. s.
Arisaema triphyllum (L.) Schott.....	Jack-in-the-pulpit.....	a-w	Fresh entire plant in flower.....	1/25, f. s.
Do.....	.....do.....	a-w	Dry root.....	1/35
Orontium aquaticum L.....	Goldendrub.....	a-w	Fresh entire plant.....	1/25
Peltandra virginica (L.) Kunth.....	Virginia arrow-arum.....	a	.....do.....	1/30, f. s.
Spathyema foetida (L.) Raf.....	Skunkcabbage.....	a	Fresh leaves and root.....	1/35
Do.....	.....do.....	a-w	Dry leaves and root.....	1/50

TABLE 4.—*Botanical classification of plants extracted, together with solvent, part used, and rate of application—Continued*

Family and scientific name	Common name	Solvent	Part used	Dilution
Araliaceae:				
<i>Aralia hispida</i> Vent.	Bristly aralia	a-w	Dry root	1/25
<i>Aralia racemosa</i> L.	American spikenard	a-w	do	1/25
Aristolochiaceae:				
<i>Aristolochia serpentaria</i> L.	Virginia snakeroot	a-w	do	1/25
<i>Asarum canadense</i> L.	Canada wildginger	a-w	Dry rhizome and root	1/25
Asclepiadaceae:				
<i>Asclepias pulchra</i> Ehrh.	Hairy milkweed	a	Fresh leaves	1/25
<i>Asclepias syriaca</i> L.	Common milkweed	a	Fresh entire plant in flower	1/25
Asteraceae:				
<i>Achillea millefolium</i> L.	Common yarrow	a-w	Dry plant	1/25
Do.	do.	a	Fresh entire plant in flower	1/25
Do.	do.	a-w	do	1/25
<i>Ageratum</i> sp.	Ageratum	a	do	1/25
<i>Ambrosia elatior</i> L.	Ragweed (hogweed, bitter-weed)	a	do	1/25
<i>Anacyclus pyrethrum</i> (L.) D. C.	Pellitory	a-w	Dry root	1/25
<i>Antennaria</i> spp.	Pussytoes	a	Fresh entire plant in flower	1/25
Do.	do.	a	do	1/25
<i>Anthemis arvensis</i> L.	Corn camomile	a-w	Dry flowers	1/25
<i>Anthemis nobilis</i> L.	Common camomile	a	Fresh leaves and burs	1/30
<i>Arctium minus</i> Bernh.	Common burdock	a-w	Dry leaves	1/25, f. s.
<i>Arnica alpina</i> (L.) Olin and Ladau.	Arnica	a-w	N. F. extract	1/64
<i>Arnica montana</i> J.	Mountain arnica	a-w	Dry leaves and flowers	1/25
<i>Artemisia absinthium</i> L.	Common wormwood	a-w	Dry	1/25
<i>Artemisia dracunculoides</i> Pursh.	Tarragon	a-w	Dry whole plant	1/25
<i>Artemisia vulgaris</i> L.	Mugwort	a	Fresh leaves and flowers	1/25, f. s.
<i>Aster novae-angliae</i> L.	New England aster	a-w	do	1/25, f. s.
<i>Aster paniculatus</i> Lam.	Pyrethrum	a	Dry flowers and stems	1/100
<i>Chrysanthemum cinerariifolium</i> Vis.	Oxeye daisy	a	Fresh entire plant in flower	1/25, f. s.
<i>Chrysanthemum leucanthemum</i> L.	Feverfew	a-w	Dry entire plant	1/25
<i>Chrysanthemum parthenium</i> (L.) Bernh.	Chrysanthemum	a	Fresh leaves	1/25
<i>Chrysanthemum</i> spp. (cult.)	Chrysanthemum	a	Fresh leaves and flowers	1/25
<i>Chrysopsis mariana</i> (L.) Nutt.	Maryland golden-aster	a	do	1/35
<i>Cichorium intybus</i> L.	Chicory	a-w	Dry leaves	1/25
<i>Cnicus benedictus</i> L.	Blessed thistle	a-w	Fresh entire plant in flower	1/30
<i>Coreopsis grandiflora</i> Hogg.	Blg coreopsis	a-w	Dry rhizome and root	1/25, f. s.
<i>Echinacea pallida</i> (Nutt.) Britton.	Hedgehog-coneflower	a-w	Dry entire plant	1/25, f. s.
<i>Erechtites hieracifolia</i> (L.) Raf.	Fireweed	a	Fresh entire plant in flower	1/50
<i>Erigeron annuus</i> (L.) Pers.	Daisy fleabane	a	Fresh leaves and heads	1/25, f. s.
<i>Erigeron canadensis</i> L.	Horseweed	a	Fresh entire plant in flower	1/80, f. s.
<i>Erigeron pulchellus</i> Michx.	Poor-rhins-plantain	a	do	1/50
<i>Eupatorium coelestinum</i> L.	Mistflower	a	Fresh leaves and flowers	1/40
<i>Eupatorium hyssopifolium</i> L.	Thoroughwort	a	Fresh leaves	1/50
<i>Eupatorium perfoliatum</i> L.	Boneset	a	N. F. extract	1/64
Do.	do.	a	Fresh leaves and tops	1/50
<i>Eupatorium pubescens</i> Muhl.	Joe-pye-weed	a	Fresh leaves and huds	1/50
<i>Eupatorium purpureum maculatum</i> (L.) Darl.		a	Fresh entire plant in flower	1/25
<i>Gallsoga parviflora</i> Cav.		a	Fresh entire plant	1/25
<i>Gnaphalium obtusifolium</i> L.	Common everlasting	a	N. F. extract	1/64
<i>Grindelia camporum</i> Greene.	Grindelia	a-w	Fresh leaves and flowers	1/40, f. s.
<i>Helianthus annuus</i> L.	Common sunflower	a-w	Fresh entire plant in flower	1/25
<i>Helopsis helianthoides</i> (L.) Hawkwweed		a	do	1/30
<i>Hieracium pratense</i> Tausch.	Elecampane	a-w	Dry root	1/25
<i>Inula helenium</i> L.	Cynthis	a	Fresh entire plant in flower	1/30, f. s.
<i>Krigia hiflora</i> (Walt.) Blake.		a-w	Dry plant	1/25
<i>Lacinaria spicata</i> (L.) Kuntze.	Spike gayfeather	a	Fresh leaves	1/50
<i>Lactuca canadensis</i> L.	Wild lettuce	a		

TABLE 4.—*Botanical classification of plants extracted, together with solvent, part used, and rate of application—Continued*

Family and scientific name	Common name	Solvent	Part used	Dilution
Asteraceae—Continued.				
<i>Leontodon taraxacum</i> L.....	Dandelion.....	a	Fresh entire plant in flower.	1/30
Do.....	do.....	a	Fresh flowers and stems.....	1/35, f. s.
Do.....	do.....	a-w	Fresh flowers.....	1/30, f. s.
Do.....	do.....	a-w-c	do.....	1/25
Do.....	do.....	a-w ¹	do.....	f. s.
<i>Matricaria chamomilla</i> L.....	False-camomile.....	a-w	Dry flowers.....	1/25
<i>Rudbeckia hirta</i> L.....	Black-eyed-susan.....	a	Fresh entire plant in flower	1/30
<i>Senecio aureus</i> L.....	Golden groundsel.....		N. F. extract.....	1/64
<i>Senecio vulgaris</i> L.....	Common groundsel.....		Dry entire plant.....	1/64
<i>Sericocarpus asteroides</i> (L.) B. S. P.....	White topped aster.....	a-w	Fresh entire plant in flower.	f. s., 1/25
<i>Silphium laciniatum</i> L.....	Compassplant.....	a-w	Dry entire plant.....	1/25
<i>Solidago juncea</i> Ait.....	Early goldenrod.....	a	Fresh leaves and flowers.....	1/25
<i>Solidago</i> sp.....	Goldenrod.....	a-w	Fresh leaves.....	f. s., 1/25
<i>Sonchus oleraceus</i> L.....	Sowthistle.....	a-w	Fresh leaves and tops.....	f. s.
<i>Tagetes</i> spp.....	Marigold.....	a	Fresh leaves.....	1/25
<i>Tanacetum vulgare</i> L.....	Common tansy.....	a-w	Fresh entire plant in flower.	f. s.
<i>Vernonia noveboracensis</i> (L.) Willd.....	Common ironweed.....	a	Fresh leaves and beads.....	1/35
Balsaminaceae.				
<i>Impatiens balsamina</i> L.....	Garden balsam.....	a-w	Fresh flowers.....	f. s.
Do.....	do.....	a	do.....	f. s.
Do.....	do.....	a-w	Fresh entire plant in flower.	1/30
<i>Impatiens biflora</i> Walt.....	Spotted snapweed.....	a	Fresh leaves and stems.....	1/25
Berberidaceae:				
<i>Berberis aquifolium</i> Pursh.....	Oregon hollygrape.....		N. F. extract.....	1/64
<i>Berberis vulgaris</i> L.....	European hawberry.....	a-w	Dry root.....	1/25
<i>Berberis</i> spp.....	Barberry.....	a-w	Dry leaves.....	1/25
<i>Caulophyllum thalictroides</i> (L.) Michx.....	Blue cohosh.....		N. F. extract.....	1/64
Do.....	do.....	a	Dry root.....	1/25
<i>Jeffersonia diphylla</i> (L.) Pers.....	Twinkleleaf.....	a-w	do.....	1/25
<i>Podophyllum peltatum</i> L.....	Common mayapple.....	a	Fresh entire plant in flower.	1/30
Do.....	do.....	a-w	Dry root.....	1/25
Betulaceae:				
<i>Ostrya virginiana</i> (Mill.) Koch.....	American bophorn-beam.....	a	Dry wood.....	1/30
Bignoniaceae:				
<i>Bignonia radicans</i> L.....	Trumpet creeper.....	a	Fresh leaves and flowers.....	1/25
<i>Catalpa bignonioides</i> Walt.....	Southern catalpa.....	a	Fresh leaves.....	1/25
Boraginaceae:				
<i>Borago officinalis</i> L.....	Common borage.....	a-w	Dry flowers.....	1/25
<i>Cynoglossum officinale</i> L.....	Common houndstongue.....	a-w	Dry root.....	1/25
<i>Pulmonaria officinalis</i> L.....	Common lungwort.....	a	Dry whole plant.....	1/25
Do.....	do.....	a-w	do.....	1/25
<i>Symphytum officinale</i> L.....	Common comfrey.....		Dry root.....	1/35
Brassicaceae:				
<i>Arabisopsis thaliana</i> (L.) Britton.....	Mouse-ear cress.....	a	Fresh entire plant in flower.	1/25
<i>Brassica oleracea capitata</i> L.....	Cabbage, cultivated.....	a-w	Fresh leaves.....	1/25
<i>Brassica nigra</i> (L.) Koch.....	Black mustard.....	a-w	Fresh entire plant in flower.	f. s., 1/30
<i>Bursa hirsuta-pastoris</i> (L.) Britton.....	Shepherd's-purse.....	a-w	Dry entire plant.....	1/25
Do.....	do.....	a-w	Fresh entire plant.....	1/25
<i>Campebarbarea</i> (L.) W. F. Wight.....	Bitter wintercress.....	a	Fresh entire plant in flower	f. s., 1/30
<i>Erysimum perofskianum</i> Fisch. and Mey.....	Afghan blistercress.....	a-w	do.....	f. s.
<i>Lepidium virginicum</i> L.....	Peppergrass.....	a	Fresh entire plant.....	f. s., 1/35
<i>Radicula armoracia</i> (L.) Robinson.....	Horseradish.....	a-w	Dry root.....	1/25
Buxaceae:				
<i>Buxus sempervirens</i> L.....	Common box.....	a	Fresh leaves.....	1/50
Cactaceae:				
<i>Opuntia vulgaris</i> Mill.....	Pricklypear.....	a-w	Fresh entire plant in flower.	1/30
Campanulaceae:				
<i>Specularia perfoliata</i> (L.) A. DC.....	Venus lookingglass.....	a	do.....	1/25
Canellaceae:				
<i>Canella winterana</i> (L.) Gaertn.....	Canella.....	a-w	Dry bark.....	1/25
Caprifoliaceae:				
<i>Lonicera japonica</i> Thunb.....	Japanese honeysuckle.....	a	Fresh leaves.....	1/35
<i>Viburnum dentatum</i> L.....	Arrowwood.....	a-w	do.....	1/40

¹ Distilled.

TABLE 4.—*Botanical classification of plants extracted, together with solvent, part used, and rate of application—Continued*

Family and scientific name	Common name	Solvent	Part used	Dilution
Caryophyllaceae:				
<i>Alsine media</i> L.....	Common chickweed..	a	Fresh entire plant in flower.	1/25
<i>Saponaria officinalis</i> L.....	Bouncing-bet.....	a	do.....	1/35
<i>Siene antirrhina</i> L.....	Sleepy catchfly.....	a	do.....	1/30
Celastraceae: <i>Celastrus scandens</i> L.....	American bittersweet.	a	Fresh leaves.....	1/100
Chenopodiaceae:				
<i>Chenopodium album</i> L.....	Lamb's-quarters.....	a	Fresh entire plant.....	1/20
<i>Chenopodium ambrosioides</i> L.....	do.....	a	Fresh leaves.....	1/30
<i>Chenopodium ambrosioides anthelminticum</i> (L.) A. Gray.	Wormseed.....	a-w	Fresh stems and fruit.....	1/30
Cistaceae: <i>Hedichthium candelense</i> (L.) Michx.	Sunrose.....	a-w	Dry plant.....	1/25
Combretaceae: <i>Terminalia catappa</i> L.....	India-almond.....		Commercial extract.....	1/25
Convolvulaceae:				
<i>Exogonium jalapa</i> (L.) Hayne.	Jalap.....		N. F. extract.....	1/64
<i>Ipomoea pandurata</i> (L.) Meyer.	do.....	a	Fresh leaves and flowers..	1/25
Cornaceae:				
<i>Cornus florida</i> L.....	Flowering dogwood....	a	Fresh leaves.....	1/35
<i>Nyssa sylvatica</i> Marsh.....	Tupelo.....	a-w	do.....	1/25
Cucurbitaceae: <i>Citrullus colocynthis</i> Schrad.	Colocynth.....		U. S. P. extract.....	1/100
Dipsacaceae: <i>Scabiosa atropurpurea</i> L.....	Sweet scabiosa.....	a-w	Fresh entire plant in flower.	1/25
Droseraceae: <i>Drosera rotundifolia</i> L.....	Roundleaf sundew.....	a	Dry entire plant.....	1/25
Ebenaceae: <i>Diospyros virginiana</i> L.....	Common persimmon.....		Fresh leaves.....	f. s., 1/25
Equisetaceae:				
<i>Equisetum hyemale</i> L.....	Scouring-rush.....	a	Dry whole plant.....	1/30
<i>Equisetum arvense</i> L.....	Common horsetail.....	a	Fresh entire plant.....	f. s., 1/30
Ericaceae:				
<i>Arctostaphylos uva-ursi</i> (L.) Spreng.	Bearberry.....		U. S. P. extract.....	1/64
Do.....	do.....	a-w	Dry leaves.....	1/25
<i>Azalea nudiflora</i> L.....	Pinkerbloom.....	a	Fresh leaves and flowers..	f. s.
<i>Chimaphila umbellata</i> (L.) Barton.	Common pipsissewa....	a-w	Dry entire plant.....	1/25
Do.....	do.....		N. F. extract.....	1/64
<i>Epigaea repens</i> L.....	Trailing-arbutus.....	a-w	Dry entire plant.....	1/25
<i>Gaultheria procumbens</i> L.....	Wintergreen.....	a-w	Fresh leaves.....	1/25
<i>Kalmia latifolia</i> L.....	Mountain-laurel, kalmia.	a	Dry leaves.....	1/25
Do.....	do.....	a	Fresh leaves.....	1/30
<i>Kalmia angustifolia</i> L.....	Lambkill.....	a-w	do.....	f. s.
Do.....	do.....	a	do.....	1/40
<i>Oxydendrum arboreum</i> (L.) D. C.	Sourwood.....	a-w	Dry leaves.....	1/25
<i>Vaccinium</i> sp.....	Blueberry.....	a-w	Fresh leaves and berries..	f. s.
Euphorbiaceae:				
<i>Euphorbia hirsuta</i> (Torr.) Wiegand.	Spurge.....	a-w	Dry entire plant.....	1/25
Do.....	do.....		N. F. extract.....	1/64
<i>Euphorbia ipecacuanhae</i> L.....	Ipecac spurgo.....	a	Fresh entire plant in flower.	1/30
<i>Mallotus philippinensis</i> (Lamarck) Muell-Arg.	Kamala.....	a-p	Dry berries.....	1/25
<i>Ricinus communis</i> L.....	Common castor-bean....	a-w	Fresh leaves.....	f. s., 1/25
Do.....	do.....	a	do.....	f. s.
<i>Stillingia sylvatica</i> L.....	Stillingia.....	a-w	Dry root.....	f. s., 1/25
Fabaceae:				
<i>Acacia longifolia</i> Willd.....	Sydney wattle.....		Commercial extract.....	1/25
<i>Acacia catechu</i> Willd.....	Cutch.....		do.....	1/25
<i>Baptisia tinctoria</i> (L.) R. Br.	Yellow wild-indigo....	a	Fresh leaves and stems....	1/50
Do.....	do.....	a	Dry root.....	1/50
<i>Caesalpinia coriaria</i> Willd.....	Divi-divi.....		Commercial extract.....	1/25
<i>Cassia chamaecrista</i> L.....	Partridge-pea.....	a	Fresh leaves and flowers..	1/40
<i>Cassia marilandica</i> L.....	Wild senna.....	a	Fresh entire plant in flower.	f. s., 1/25
<i>Cracca virginiana</i> L.....	Goatsruc.....	a-w	Dry whole plant in flower.	1/25
<i>Cytisus scoparius</i> (L.) Link.	Scotch broom.....	a-w	Dry tops.....	1/25
Do.....	do.....		N. F. extract.....	1/64
<i>Deguelia malaccensis</i> (Benth.) Blake.	Derris.....	b	Dry root.....	1/25, 1/35
Do.....	do.....	a	do.....	1/25, 1/100
Do.....	do.....	a-w	do.....	1/50

TABLE 4.—*Botanical classification of plants extracted, together with solvent, part used, and rate of application*—Continued

Family and scientific name	Common name	Solvent	Part used	Dilution
Fabaceae—Continued.				
<i>Galega officinalis</i> L.....	Common goatsrue.....	a-w	Dry whole plant in flower.....	1/25
<i>Genista tinctoria</i> L.....	Woadwaxen.....	a-w	Dry flowers and seeds.....	1/25
<i>Glycyrrhiza glabra</i> L.....	Common licorice.....	a-w	Dry root.....	1/25
<i>Gymnocladus dioica</i> (L.) Koch.....	Kentucky coffeetree.....	a	Fresh leaves.....	1/35
<i>Haematoxylon campechianum</i> L.....	Logwood (hematin).....		Two commercial extracts.....	1/25
<i>Ichthyomethia piscipula</i> (L.) Hitchc.....	Jamaica fish-poison.....	a	Dry bark.....	1/35
Do.....	do.....	a-b-g	do.....	1/25
Do.....	do.....	a-g	do.....	1/35
<i>Lupinus perennis</i> L.....	Sun-dial lupine.....	a	Fresh entire plant in flower.....	1/30
<i>Melilotus alba</i> Desv.....	White sweet clover.....	a	do.....	1/25
<i>Melilotus officinalis</i> (L.) Lam.....	Yellow sweet clover.....	a	do.....	1/25
<i>Physostigma venenosum</i> Balf.....	Calabar-bean.....	a-w	Dry seeds.....	1/25
<i>Psoralea pedunculata</i> (Mill.) Vail.....	Sampson-snakeroot.....	a-w	Dry root.....	1/25
<i>Robinia pseudacacia</i> L.....	Common locust.....	a	Fresh leaves.....	1/35
<i>Stylosanthes biflora</i> (L.) B. S. P.....	Pencil flower.....	a	Fresh leaves and flowers.....	1/25
<i>Trifolium agrarium</i> L.....	Hop clover.....	a	Fresh entire plant in flower.....	1/25
<i>Trifolium arvense</i> L.....	Rabbit-foot clover.....	a	do.....	1/25
<i>Trigonella foenum-graecum</i> L.....	Fenugreek.....	a-w	Dry seed.....	1/25
<i>Vicia villosa</i> Roth.....	Hairy vetch.....	a	Fresh entire plant in flower.....	1/25
Fagaceae:				
<i>Castanea dentata</i> (Marsh.) Borkh.....	American chestnut.....		Commercial extract.....	1/25
<i>Fagus grandifolia</i> Ehrh.....	American beech.....	a	Fresh leaves.....	1/25
<i>Quercus borealis maxima</i> (Marsh.) Ashe.....	Common red oak.....	a	do.....	1/25
<i>Quercus velutina</i> Lam.....	Black oak (quercitron).....	a	do.....	1/25
Do.....	do.....		Commercial extract.....	1/25
<i>Quercus</i> spp.....	Gallnut.....		do.....	1/25
Do.....	Valonia.....		do.....	1/25
Fumariaceae:				
<i>Bikukulla canadensis</i> (Goldie) Mills.....	Squirrelcorn.....	a-w	Dry tubers.....	1/25
<i>Fumaria officinalis</i> L.....	Common fumitory.....	a-w	Dry entire plant.....	1/25
Gentianaceae:				
<i>Gentiana lutea</i> L.....	Yellow gentian.....	a-w	Dry root.....	1/25
<i>Menyanthes trifoliata</i> L.....	Common bogbean.....	a-w	Dry leaves.....	1/25
<i>Sabbatia angularis</i> (L.) Pursh.....	Rosgentian.....	a-w	Dry entire plant in flower.....	1/25
<i>Swerthia chirayita</i> (Roxb.) Lyons.....	Chiretta.....	a-w	Dry entire plant.....	f. s., 1/25
Geraniaceae:				
<i>Geranium carolinianum</i> L.....	Cranesbill geranium.....	a	Fresh entire plant in flower.....	f. s., 1/30
Ginkgoaceae:				
<i>Ginkgo biloba</i> L.....	Maidenhair-tree.....	a	Fresh leaves.....	1/25, 1/35
Do.....	do.....	p	do.....	1/100
Haemodorracae:				
<i>Gyrotheca tinctoria</i> (Walt.) Salisb.....	Redroot.....	a-w	Fresh entire plant in flower.....	f. s.
Hamamelidaceae:				
<i>Hamamelis virginiana</i> L.....	Common witch-hazel.....		N. F. extract.....	5/64
<i>Liquidambar styraciflua</i> L.....	Sweetgum.....	a	Fresh leaves.....	f. s., 1/25
Hydrophyllaceae:				
<i>Eriodictyon californicum</i> (Hook. and Arn.) Greene.....	Yerba santa.....	a-w	Dry leaves.....	1/25
Hypericaceae:				
<i>Hypericum perforatum</i> L.....	St. Johnswort.....	a	Dry entire plant.....	1/25
Do.....	do.....	a	Fresh entire plant in flower.....	1/25
Iridaceae:				
<i>Crocus sativus</i> L.....	Crocus (saffron, Amer.).....	a-w	Dry entire plant.....	1/25
<i>Iris versicolor</i> L.....	Blueflag iris.....	a	Fresh entire plant in flower.....	1/30
<i>Sisyrinchium</i> sp.....	Blue-eyed-grass.....	a	do.....	1/30
Juglandaceae:				
<i>Hicoria</i> sp.....	Hickory.....	a	Fresh leaves.....	1/25
<i>Hicoria glabra</i> (Mill.) Britton.....	Pignut.....	a	Fresh leaves.....	1/25
<i>Juglans cinerea</i> L.....	Butternut.....	a-w-g	Dry bark of root.....	1/25

TABLE 4.—*Botanical classification of plants extracted, together with solvent, part used, and rate of application—Continued*

Family and scientific name	Common name	Solvent	Part used	Dilution
Juncaceae: <i>Juncus effusus</i> L.	Common rush.....	a	Fresh entire plant in flower.	1/30
Lauraceae:				
<i>Benzoin aestivale</i> (L.) Nees.	Spicebush.....	a	Fresh leaves and berries...	1/25
<i>Laurus nobilis</i> L.....	Grecian laurel.....	a-w	Dry leaves.....	1/25
Do.....	do.....	a	do.....	1/25
Liliaceae:				
<i>Allium canadense</i> L.....	Meadow garlic.....	a	Fresh stems and bulbs.....	f. s., 1/30
<i>Aloe vera</i> L.....	True aloa.....	a-w	Dry leaves.....	f. s., 1/25
<i>Colchicum autumnale</i> L...	Common autumn-crocus.	-----	U. S. P. extract.....	1/64
<i>Convallaria majalis</i> L.....	Lily-of-the-valley.....	a-w	Dry leaves.....	1/25
<i>Erythronium americanum</i> Ker.	Common troutlily.....	a	Fresh entire plant in flower.	f. s., 1/30
<i>Helonias bullata</i> L.....	Swamp-pink.....	a	do.....	1/30
<i>Hemerocallis fulva</i> L.....	Tawny daylily.....	a	do.....	f. s., 1/30
<i>Hyacinthus orientalis</i> L....	Common hyacinth (cult.).	a	Fresh flowers and stems...	1/25
<i>Lilium superbum</i> L.....	American Turkscap lily.	a	Fresh leaves and pods.....	1/35
<i>Madeola virginiana</i> L.....	Cucumber-root.....	a	Fresh leaves and stems....	1/25
<i>Ornithogalum umbellatum</i> L.	Common star-of-Bethlehem.	a	Fresh entire plant in flower.	1/30
<i>Polygonatum biflorum</i> (Walt.) Ell.	Small Solomonseal.....	a-w	Dry entire plant.....	1/25
<i>Polygonatum commutatum</i> Dietr.	Great Solomonseal.....	a	Fresh entire plant in flower.	1/25
<i>Schoenocaulon officinale</i> Schecht.	Sabadilla.....	a-ac	Dry seed.....	1/25
<i>Smilax rotundifolia</i> L.....	Common greenbrier.....	a	Fresh leaves.....	1/25
<i>Trillium erectum</i> L.....	Purple trillium.....	a-w	Dry rhizome and root.....	1/25
<i>Tulipa gesneriana</i> L.....	Common tulip.....	a	Fresh entire plant in flower.	1/30
<i>Unifolium canadense</i> (Desf.) Greene.	do.....	a	do.....	1/30
<i>Urginea maritima</i> (L.) Baker.	Sea-onion.....	a-w	Dry bulb.....	1/50
Do.....	do.....	-----	U. S. P. extract.....	1/64
<i>Uvularia perfoliata</i> L.....	Wood merrybells.....	a	Fresh entire plant in flower.	f. s., 1/35
<i>Vagnera trifolia</i> (L.) Morong.	False Solomonseal.....	a	do.....	1/25, 1/35
<i>Veratrum viride</i> Ait.....	American false-hellebore.	a-w	Dry root.....	1/25
Do.....	do.....	-----	U. S. P. extract.....	1/64
Do.....	do.....	a	Fresh leaves and stems....	1/30
<i>Veratrum album</i> L.....	False-hellebore.....	a-w	Dry root.....	1/25
Lobeliaceae:				
<i>Lobelia inflata</i> L.....	Indian-tobacco.....	a-w	Dry leaves and tops.....	1/25
Do.....	do.....	-----	N. F. extract.....	1/64
<i>Lobelia cardinalis</i> L.....	Cardinalflower.....	a-w	Fresh entire plant in flower.	f. s., 1/25
Loganiaceae:				
<i>Strychnos ignatii</i> Bergius..	Ignatia.....	a-w	Dry beans.....	1/25
<i>Strychnos nux-vomica</i> L....	Nux vomica.....	-----	N. F. extract.....	1/64
Loranthaceae: <i>Phoradendron flavescens</i> (Pursh.) Nutt.	American mistletoe.....	a-w	Dry entire.....	1/25
Lythraceae: <i>Lythrum salicaria</i> L.	Purple loosestrife.....	a-w	Fresh entire plant in flower.	1/25
Magnoliaceae:				
<i>Liriodendron tulipifera</i> L....	Tuliptree.....	a	Fresh leaves.....	1/25
<i>Magnolia virginiana</i> L.....	Sweetbay.....	a	do.....	f. s.
Malvaceae: <i>Hibiscus trionum</i> L.	Flower-of-an-hour.....	a	Fresh entire plant in flower.	1/25
Meliaceae: <i>Guarea rusbyi</i> (Britton) Rushy.	Coccoloba.....	a-w	Dry bark.....	f. s., 1/25
Menispermaceae:				
<i>Anamirta cocculus</i> (L.) Wight and Arn.	Fish-herries.....	a-w	Dry fruit.....	1/25
Do.....	do.....	-----	N. F. extract.....	1/64
Menthaceae:				
<i>Collinsonia canadensis</i> L....	Citronella horsebalm....	a-w	Dry entire plant.....	1/25
<i>Cunila origanoides</i> (L.) Britton.	Stonemint.....	a-w	do.....	1/25
<i>Hedeoma pulegioides</i> (L.) Pers.	Pennyroyal.....	a-w	Dry leaves.....	1/25
<i>Hyssopus officinalis</i> L.....	Hyssop.....	a-w	do.....	1/25
<i>Koelia flexuosa</i> (Walt.) MacM.	Slender mountain-mint.	a	Fresh leaves and stems....	1/25
<i>Lamium amplexicaule</i> L.....	Deadnattle.....	a	Fresh entire plant in flower.	1/30

TABLE 4.—*Botanical classification of plants extracted, together with solvent, part used, and rate of application—Continued*

Family and scientific name	Common name	Solvent	Part used	Dilution
Menthaceae—Continued.				
<i>Leonurus cardiaca</i> L.	Common motherwort.	a-w	Dry entire plant.	1/25
<i>Lycopus virginicus</i> L.	Bugleweed	a-w	do.	1/25
<i>Marrubium vulgare</i> L.	Common hoarhound.	a	Fresh leaves and stems.	1/25
Do.	do.	a-w	Dry leaves	1/30
<i>Mentha spicata</i> L.	Spearmint.	a-w	Dry leaves and tops.	f. s., 1/25
<i>Mentha canadensis</i> L.	American wild mint.	a-w	Fresh entire plant in flower.	f. s., 1/2
Do.	do.	do.	do.	1/25
<i>Mentha arvensis</i> L.	Field mint	a-w	do.	1/25
<i>Monarda punctata</i> L.	Spotted bee-balm.	a	Fresh leaves and flowers.	1/25
<i>Monarda</i> sp.	Beebalm.	a	Fresh entire plant.	1/25
<i>Nepeta cataria</i> L.	Catnip.	a	Fresh leaves and stems.	f. s., 1/25
Do.	do.	a-w	Dry leaves	1/25
Do.	do.	do.	N. F. extract.	1/64
<i>Nepeta hederacea</i> (L.) Trevisan.	Ground-ivy.	a	do.	1/25
Do.	do.	a	Fresh entire plant in flower.	f. s., 1/35
<i>Origanum majorana</i> L.	Sweet marjoram.	a-w	Dry leaves and flowers.	1/25
<i>Rosmarinus officinalis</i> L.	Rosemary.	a-w	Dry leaves	1/25
Do.	do.	a-w	Dry flowers.	1/25
<i>Salvia splendens</i> Ker.	Scarlet sage.	a	Fresh entire plant in flower.	1/30
<i>Salvia triloba</i> L.	Oreek sage.	a-w	Dry leaves	1/25
<i>Satureia hortensis</i> L.	Summer savory.	a-w	do.	1/25
<i>Scutellaria lateriflora</i> L.	Mad-dog skullcap.	a-w	Dry entire plant.	1/25
Do.	do.	do.	N. F. extract.	1/64
Do.	do.	a	Fresh entire plant in flower.	1/25
<i>Stachys officinalis</i> (L.) Franch.	Common betony.	a-w	Dry entire plant.	1/25
<i>Teucrium canadense</i> L.	American germander.	a-w	Fresh entire plant in flower.	f. s., 1/25
<i>Thymus vulgaris</i> L.	Common thyme.	a-w	Dry leaves	1/25
Do.	do.	do.	N. F. extract.	1/64
Monimiaceae: <i>Peumus boldus</i> Mol.	Boldo.	a	Dry leaves	1/25
Moraceae: <i>Chlorophora tinctoria</i> (L.) Gaud.	Fustic.	do.	Commercial extract.	1/25
Myricaceae:				
<i>Comptonia peregrina</i> (L.) Coult.	Sweetfern.	a	Fresh leaves.	1/50
<i>Myrica cerifera</i> L.	Southern waxmyrtle.	a-w	Dry bark of root.	1/30
<i>Myrica carolinensis</i> Mill.	Northern bayberry.	a	Fresh leaves and berries.	1/30
Myrtaceae:				
<i>Eucalyptus globulus</i> Labill.	Blue gum.	a-w	Dry leaves	1/25
Do.	do.	do.	U. S. P. extract.	1/64
<i>Syzygium cumini</i> (L.) Skeels.	Jambolan-plum.	a-w	Dry bark and seeds.	1/25
Nymphaeaceae: <i>Nymphaea alba</i> Ait.	Spatterdock.	a	Fresh leaves and stems.	1/30
Oleaceae:				
<i>Chionanthus virginica</i> L.	White fringe tree.	a-w	Dry bark of root.	1/25
<i>Fraxinus americana</i> L.	White ash.	a	Fresh leaves	1/25
<i>Ligustrum vulgare</i> L.	European privet.	a	do.	1/25
<i>Syringa vulgaris</i> L.	Common lilac.	a	Fresh leaves and flowers.	f. s., 1/30
<i>Orchidaceae:</i> <i>Habenaria blephariglossis</i> (Willd.) Torr.	White fringe-orchid.	a-w	Fresh entire plant in flower.	f. s.
Osmundaceae: <i>Osmunda cinnamomea</i> L.	Cinnamon fern.	a	Fresh young fronds.	1/30
Oxalidaceae: <i>Oxalis stricta</i> L.	Common yellow oxalis.	a	Fresh entire plant in flower.	f. s., 1/35
Papaveraceae:				
<i>Chelidonium majus</i> L.	Celandine.	a-w	Dry entire plant.	1/25
Do.	do.	a	Fresh entire plant in flower.	1/30
Passifloraceae: <i>Passiflora incarnata</i> L.	Maypop.	a-w	Dry entire plant.	1/25
Pheniceae:				
<i>Areca catechu</i> L.	Betel palm.	a-w	Dry nuts.	1/50
<i>Serenoa serrulata</i> (Michx.) Hooker.	Saw palmetto.	a-w	Dry berries.	1/25
Phytolaccaceae:				
<i>Phytolacca americana</i> L.	Common pokeberry.	a-w	do.	1/50
Do.	do.	a-w	Dry root.	1/30
Do.	do.	a	Fresh leaves and stems.	1/50
Pinaceae:				
<i>Abies concolor</i> (Oord.) Murray.	White fir.	p	Fresh leaves and twigs.	1/50
Do.	do.	a	do.	1/50, 1/100
<i>Abies veitchii</i> Lindl.	Veitch fir.	a	Fresh leaves.	1/35
<i>Chamaecyparis thyoides</i> (L.) B. S. P.	Whitecedar.	a-w	do.	1/25

TABLE 4.—*Botanical classification of plants extracted, together with solvent, part used, and rate of application—Continued*

Family and scientific name	Common name	Solvent	Part used	Dilution
Pinaceae—Continued.				
<i>Juniperus sabina</i> L.	Savin	a	Dry tops	1/50
<i>Juniperus virginiana</i> L.	Redcedar	a	Fresh lower leaves	1/25
<i>Juniperus communis</i> L.	Common juniper	a-w	Dry berries	1/25
<i>Picea orientalis</i> (L.) Carr.	Oriental spruce	a	Fresh leaves and twigs	1/50
<i>Pinus</i> spp.	Pine	a	Commercial	1/50
<i>Pinus virginiana</i> Mill.	Scrub pine	a	Fresh needles and young twigs	1/25
<i>Pinus rigida</i> Mill.	Pitch pine	a-w	Fresh needles	1/25
<i>Thuja occidentalis</i> L.	American arborvitae	a	Fresh leaves and twigs	1/35
<i>Tsuga canadensis</i> (L.) Carr.	Canada hemlock	a-w	do.	1/25
Do.	do.		Commercial extract	1/25
Piperaceae:				
<i>Piper angustifolium</i> Ruiz and Pavon.	Matteo	a-w	Dry leaves	1/25
<i>Saururus cernuus</i> L.	Common lizardtail	a-w	Fresh entire plant	1/25
Plantaginaceae:				
<i>Plantago major</i> L.	Common plantain	a	Dry leaves	1/25
Do.	do.	a	Fresh entire plant	f. s.
<i>Plantago lanceolata</i> L.	Buckhorn plantain	a-w	do.	f. s.
Poaceae:				
<i>Agropyron repens</i> (L.) Beauv.	Quackgrass	a	Dry rhizome and root	1/50
<i>Holcus lanatus</i> L.	Velvet grass	a	Fresh entire plant in flower.	1/30
Polemoniaceae:				
<i>Phlox subulata</i> L.	Moss phlox	a	do.	f. s., 1/25
<i>Phlox paniculata</i> L.	Garden phlox	a	Fresh plant in flower	1/30
Polygalaceae: <i>Polygala senega</i> L.	Seneca-snakeroot		N. F. extract	1/64
Polygonaceae:				
<i>Fagopyrum vulgare</i> Hill	Common buckwheat	a	Fresh entire plant	f. s., 1/25
<i>Rumex acetosa</i> L.	Garden sorrel	a	do.	1/25
Polypodiaceae:				
<i>Adiantum capillus-veneris</i> L.	Southern maidenhair	a-w	Dry entire plant	1/25
<i>Phyllitis scolopendrium</i> (L.) Newman.	Hartstongue	a-w	Dry fronds	1/25
<i>Pteridium aquilinum</i> (L.) Kuhn.	Bracken	a-w	Fresh fronds	1/25
Polyporaceae: <i>Polyporus officinalis</i> Fries.	Agaric	a-w	Dry fruit	1/25
Polytrichaceae: <i>Polytrichum juniperinum</i> Willd.	Haircap moss	a-w	Dry entire plant	1/25
Pontederiaceae: <i>Pontederia cordata</i> L.	Pickersweed	a	Fresh entire plant	1/25
Portulacaceae: <i>Claytonia virginica</i> L.	Virginia springbeauty	a	Fresh entire plant in flower.	1/25
Plumbaginaceae: <i>Limonium carolinianum</i> (Walt.) Britton.	Sea-lavender	a-w	do.	1/25
Primulaceae: <i>Lysimachia terrestris</i> (L.) B. S. P.	Swampcandle	a	do.	1/30
Ranunculaceae:				
<i>Aconitum napellus</i> L.	Aconite	a-w	Dry root	1/25
<i>Adonis vernalis</i> L.	Spring adonis	a-w	Dry entire plant	1/25
<i>Anemone pulsatilla</i> L.	European pasqueflower.	a-w	do.	1/25
<i>Anemone quinquefolia</i> L.	American wood anemone.	a	Fresh entire plant in flower.	f. s.
<i>Caltha palustris</i> L.	Marshmarigold	a	do.	f. s., 1/35
<i>Cimicifuga racemosa</i> (L.) Nutt.	Cohosh bugbane		U. S. P. extract	1/64
Do.	do.		Dry root	1/25
<i>Delphinium staphisagria</i> L.	Larkspur	a-w	Dry seed	1/50
<i>Helleborus niger</i> L.	Christmas-rose	a-w	Dry rhizome	1/25
<i>Helleborus foetidus</i> L.	Hellebore	a-w	Dry rhizome and root	1/25
<i>Hepatica triloba</i> Chaix.	Roundlobe hepatica.	a-w	Dry leaves	1/25
<i>Hydrastis canadensis</i> L.	Goldenseal		U. S. P. extract	1/64
<i>Nigella sativa</i> L.	Fennel flower	a-w-c	Dry seed (2 extracts)	1/25, f. s.
Do.	do.	a-w-c	do.	1/25, f. s.
<i>Ranunculus septentrionalis</i> Poir.	Swamp buttercup	a	Fresh entire plant in flower.	1/30
<i>Thalictrum polygamum</i> Muhl.	Tall meadowrue	a	Fresh leaves and flowers	1/50
Resedaceae: <i>Reseda odorata</i> L.	Common mignonette	a	Fresh entire plant in flower.	f. s.
Rhamnaceae:				
<i>Ceanothus americanus</i> L.	Jersey-tea	a	Fresh leaves and flowers	1/30
<i>Rhamnus cathartica</i> L.	Common buckthorn	a	Dry berries	1/50

TABLE 4.—*Botanical classification of plants extracted, together with solvent, part used, and rate of application*—Continued

Family and scientific name	Common name	Solvent	Part used	Dilution
Rosaceae:				
<i>Hagenia abyssinica</i> Gmel.	Koussou	a	Dry flowers	1/25
<i>Potentilla argentea</i> L.	Silver cinquefoil	a	Fresh entire plant in flower.	1/30
<i>Pyrus communis</i> L.	Common pear (Kieffer)	a	Fresh leaves	1/25
<i>Pyrus</i> sp.	Common pear	a-w	do	1/25
<i>Quillaja saponaria</i> Mol.	Soapbark		N. F. extract	1/64
Rubiaceae:				
<i>Cephalanthus occidentalis</i> L.	Common huttonhush	a	Fresh leaves and flowers	1/35
<i>Cinchona succubra</i> Pavon	Cinchona	a-w-g	Dry bark	1/25
<i>Galium aparine</i> L.	Bedstraw	a-w	Dry entire plant	1/25
<i>Galium triflorum</i> Michx.	Fragrant bedstraw	a	Fresh leaves and stems	1/50
<i>Mitchella repens</i> L.	Partridgeberry	a-w	Dry entire plant	1/25
<i>Ouroparia gambia</i> (Hun-ter) Baillon.	Gambier		Commercial extract	1/25
Rutaceae:				
<i>Barosma betulina</i> (Thunb.) Bartl. and Wendl.	Buchu		U. S. P. extract	1/25
<i>Pilocarpus jaborandi</i> Holmes.	Pilocarpus		N. F. extract	1/64
Do.	do	a-w	Dry leaves	1/25
<i>Ruta graveolens</i> L.	Common rue	a-w	Dry entire plant	1/25
<i>Zanthoxylum americanum</i> Mill.	Common prickly-ash	a-w	Dry bark	f. s., 1/25
Salicaceae: <i>Populus nigra</i> L.	Black poplar		Dry huds.	1/25
Santalaceae: <i>Comandra umbellata</i> (L.) Nutt.	Comandra	a	Fresh entire plant in flower	1/25
<i>Parietaria pennsylvanica</i> Muhl.	Pellitory	a-w	Dry root	1/25
Saxifragaceae: <i>Hydrangea arborescens</i> L.	Smooth hydrangea	a-w	do	1/25
Scrophulariaceae:				
<i>Antirrhinum</i> spp.	Snapdragon	a	Fresh entire plant in flower.	1/25
<i>Aureolaria pedicularia</i> (L.) Raf.	Gerardia	a	Fresh leaves and flowers	1/30
<i>Chelone glabra</i> L.	White turtlehead	a-w	Dry leaves	1/25
<i>Digitalis purpurea</i> L.	Common foxglove		N. F. extract	1/100
<i>Euphrasia officinalis</i> L.	Eyebright	a-w-ac	Dry entire plant	1/25
<i>Linaria vulgaris</i> Hill.	Common toadflax	a	Fresh entire plant in flower.	f. s., 1/25
<i>Melampyrum lineare</i> Lam.	Cowwheat	a-w	Fresh entire plant	1/25
<i>Scrophularia marylandica</i> L.	Figwort	a-w	Dry leaves	1/25
<i>Verhascum thapsus</i> L.	Common mullein		N. F. extract	1/64
Do.	do	a	Fresh leaves and heads	1/40
<i>Veronica officinalis</i> L.	Common speedwell	a-w	Dry entire plant	1/25
<i>Veronica virginica</i> L.	Culvers-physic	a-w	Dry rhizome and root	1/25
Simaroubaeae:				
<i>Ailanthus altissima</i> (Mill.) Swingle.	Ailanthus	a	Fresh leaves	f. s., 1/25
Do.	do	a-w	do	f. s., 1/25
<i>Picrasma excelsa</i> (Sw.) Planch.	Quassia	a-w	Dry chips	1/35
Do.	do		N. F. extract	1/64
Solanaceae:				
<i>Atropa belladonna</i> L.	Belladonna		U. S. P. extract	1/64
<i>Datura stramonium</i> L.	Jimsonweed		do	1/100
Do.	do		Dry leaves	1/25
<i>Hyoscyamus niger</i> L.	Henbane		U. S. P. extract	1/125
<i>Lycopersicon esculentum</i> Mill.	Tomato		Juice from fresh leaves	1/2-1/4
Do.	do	a	Fresh leaves	1/25
Do.	do	a ¹	do	1/100
Do.	do	a-w	do	1/4-1/35
<i>Nicotiana glauca</i> L.	Common tobacco		Commercial extract	(6 extr.)
Do.	do		Juice from leaves	1/2-1/4
Do.	do		Leaf wax	f. s.
Do.	do	a	Fresh leaves	1/10
Do.	do	p	do	1/25
Do.	do	an	Fresh leaves	1/25
Do.	do	pn	do	1/25
Do.	do	a ¹	do	1/10
<i>Petunia hybrida</i> Vilm.	Common petunia	a	Fresh flowers	1/25, f. s.
Do.	do	a-w	Fresh plant in flower	1/25, f. s.
<i>Solanum carolinense</i> L.	Horsenettle		N. F. extract	1/64
Do.	do	a-w	Dry root	f. s., 1/25
Do.	do	a-w	Dry berries	1/25

¹ Distilled.² Recovered.

TABLE 4.—*Botanical classification of plants extracted, together with solvent, part used, and rate of application*—Continued

Family and scientific name	Common name	Solvent	Part used	Dilution
Solanaceae—Continued.				
<i>Solanum dulcamara</i> L.....	Bitter nightshade.....	-----	N. F. extract.....	1/64
Do.....	do.....	a-w	Dry twigs.....	1/25
<i>Solanum tuberosum</i> L.....	Potato.....	-----	Juice from fresh leaves.....	1/2-1/4
Do.....	do.....	a	Fresh leaves.....	1/10-1/25
Do.....	do.....	p	do.....	1/50
Do.....	do.....	a-w	do.....	1/50
Sparganiaceae: <i>Sparganium</i>	Bur-weed.....	a	Fresh leaves and hurs.....	1/25
<i>americanum</i> Nutt.				
Taxaceae: <i>Taxus cuspidata</i>	Japanese yew.....	a	Fresh leaves and twigs.....	1/25
Sieb. and Zucc.				
Tropaeolaceae:				
<i>Tropaeolum majus</i> L.....	Common nasturtium.....	a	Fresh plant in flower.....	f. s.
Do.....	do.....	a-w	do.....	1/25
Typhaceae:				
<i>Typha latifolia</i> L.....	Common cattail.....	a	Fresh entire plant.....	1/25, f. s.
<i>Typha angustifolia</i> L.....	Narrowleaf cattail.....	a	do.....	1-1/25
Urticaceae:				
<i>Cannabis sativa</i> L.....	Common hemp.....	-----	U. S. P. extract.....	1/64
<i>Humulus lupulus</i> L.....	Common hop.....	a-w	Dry strobile.....	1/25
<i>Morus</i> sp.....	Mulberry.....	a	Fresh leaves.....	f. s., 1/25
<i>Toxylon pomiferum</i> Raf.....	Osage-orange.....	-----	Commercial extract.....	1/25
Verbenaceae:				
<i>Lippia dulcis</i> Trevir.....	Lippia.....	a-w	Dry.....	1/25
<i>Verbena hastata</i> L.....	Blue vervain.....	a	Fresh leaves and flowers.....	1/35
Violaceae:				
<i>Viola tricolor</i> L.....	Common pansy.....	a-w	Dry entire plant.....	1/50
<i>Viola papilionacea</i> Pursh.....	Butterfly violet.....	a	Fresh entire plant in flower.....	1/30
Zingiberaceae:				
<i>Alpinia officinarum</i> Hance.....	Galangal.....	a-w	Dry rhizome.....	1/25
<i>Curcuma zedoaria</i> Rose.....	Zedoary.....	a-w	do.....	1/25

NOTE.—N. F. and U. S. P. extracts (made according to their respective standards) were purchased. The extracts designated as "commercial" are ones which are used in tanning and as dyestuffs, with the exception of those from tobacco.

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